

New, locally endemic taxa in *Leucopogon* (Ericaceae: Styphelioideae: Styphelieae) from the Perth and midwest regions of Western Australia

Michael Hislop

Western Australian Herbarium, Department of Environment and Conservation,
Locked Bag 104, Bentley Delivery Centre, Western Australia 6983

Abstract

Hislop, M. New, locally endemic taxa in *Leucopogon* (Ericaceae: Styphelioideae: Styphelieae) from the Perth and midwest regions of Western Australia. *Nuytsia* 21(2): 75–89. Four new taxa, *Leucopogon maritimus* Hislop, *L. nitidus* Hislop, *L. stokesii* Hislop, and *L. squarrosus* Benth. subsp. *irigynus* Hislop are described and mapped; the first three are illustrated. All have very restricted distributions and are of high conservation priority. Lectotypes for *L. squarrosus* and *L. brachycephalus* DC. var. *heterophyllus* Sond. are designated.

Introduction

With over 350 taxa in Western Australia's Southwest Botanical Province, the family Ericaceae (formerly segregated as Epacridaceae) is the fifth largest within a region that is globally recognised as a hotspot of botanical diversity (e.g. Myers *et al.* 2000). In common with Fabaceae, Myrtaceae and Proteaceae, the three dicot families with greater numbers in the SWBP, Ericaceae includes many narrow-range endemics (Hopper & Gioia 2004).

Ongoing taxonomic research into the three largest Western Australian genera within the family, *Leucopogon* R.Br., *Andersonia* R.Br. and *Astroloma* R.Br., indicates that all include significant numbers of undescribed taxa (c. 80, 20 & 10 respectively, are listed on *Florabase* in Western Australian Herbarium 1998–), many of which are regional or local endemics. The figure for *Leucopogon* includes members of both *Leucopogon s. str.* and of the several other taxonomic elements currently included in that genus. Of the more than 200 *Leucopogon* taxa (formal and informal names) now listed on the Census of Western Australian Plants, in the order of fifty percent are true *Leucopogons* and the balance will eventually need to be transferred to other genera. Quinn *et al.* (2003) presents the most recent published research dealing with the molecular phylogeny of *Styphelieae* which clearly demonstrates the polyphyletic status of *Leucopogon* as now constituted. Hislop & Chapman (2007) elucidate the morphological characters by which *Leucopogon s. str.* can be separated from the other elements currently included within that genus.

The primary purpose of this paper is to formally describe four locally endemic taxa of *Leucopogon s. str.* with high conservation priority.

Methods

This study was based on an examination of dried specimens housed at PERTH. The details of the methods used to measure plant parts and make other morphological observations are as described previously (Hislop 2009a). The inflorescence type of the species treated in this paper is of the kind described for the *Leucopogon gracilis* group (Hislop 2009b). The basal point of the terminal inflorescence for that species is therefore taken to be the lowest axil from which a single flower arises (below which multi-flowered axillary inflorescences are usually present), and for axillary inflorescences, the point of attachment to the main axis. The fertile bract measurements are taken from the upper three inflorescence nodes only.

The distribution map was compiled using DIVA-GIS Version 5.2.0.2 and based on PERTH specimen data.

Taxonomy

Leucopogon maritimus Hislop *sp. nov.*

Leucopogi squarroso subsp. *squarroso* affinis sed ovario 3(4)-loculari, sepalis minus acutis; a subsp. *trigyno* stylo brevior; ab ambobus foliis incurvis non recurvis, petiolo bene manifesto non sessili vel subsessili differt.

Typus: Wilbinga [north of Yanchep], Western Australia [precise locality withheld for conservation reasons], 2 May 2008, *M. Hislop* 3770 A (*holo*: PERTH 07970870; *iso*: CANB, K, MEL, NSW).

Leucopogon sp. Perth coastal (A.S. George 17305), Western Australian Herbarium, in *FloraBase*, <http://florabase.dec.wa.gov.au> [accessed June 2010]

Low, spreading *shrubs* to c. 40 cm high and 60 cm wide, often multi-stemmed close to the base but single-stemmed at ground level with a fire-sensitive rootstock. Young *branchlets* with a moderately dense to dense, \pm dimorphic indumentum of patent, straight or somewhat decurved white hairs, the longer of which are 0.2–0.5 mm long, the shorter < 0.1 mm long, the indumentum persistent on the older stems, where it is present in longitudinal bands. *Leaves* spirally arranged, antrorse, usually steeply so, narrowly elliptic, 3.9–8.6 mm long, 1.2–2.6 mm wide; apex acute or subacute, without a differentiated callus point; base cuneate or attenuate; petiole moderately well-defined, cream or yellowish in colour, 0.3–0.6 mm long, glabrous on abaxial surface, sparsely hairy adaxially and with a few marginal hairs; lamina 0.15–0.20 mm thick, adaxially concave, incurved along the longitudinal axis; surfaces \pm concolorous; adaxial surface usually rather shiny, glabrous or sparsely hairy towards the base, the venation indistinct; abaxial surface shiny, glabrous, usually striate with 5–7 raised primary veins, less often \pm smooth, the midrib rather thicker than the other veins especially towards the apex; margins usually ciliate, often conspicuously so, with coarse antrorse or patent hairs, 0.05–0.50 mm long, occasionally \pm glabrous. *Inflorescences* erect, terminal and upper-axillary, often aggregated into compact confluences; axis 3–7 mm long with 4–12 densely arranged flowers, terminating in a bud-like rudiment or an attenuate point; axis indumentum of dense, patent hairs 0.10–0.20 mm long; flowers erect and sessile. *Fertile bracts* narrowly ovate to ovate, 0.9–1.8 mm long, 0.7–0.9 mm wide, acute or subacute. *Bracteoles* ovate, 1.1–1.8 mm long, 0.8–1.1 mm wide, acute or subacute, keeled; abaxial surface glabrous throughout or with a few hairs about the upper keel, with broad scarious margins; adaxial surface shortly appressed hairy; margins glabrous or minutely ciliolate. *Sepals* ovate

or narrowly ovate, 1.9–3.0 mm long, 0.9–1.2 mm wide, acute or subacute; abaxial surface glabrous, the central portion pale greenish or straw-coloured, sometimes faintly tinged pink, venation obscure apart from a slightly raised paler midrib, becoming scarious towards the margins; adaxial surface glabrous throughout or with a few appressed hairs towards the apex; the margins mostly glabrous, ciliolate only towards the apex with hairs 0.05–0.10 mm long. *Corolla tube* white, broadly campanulate, distinctly shorter than the sepals (by up to 1.3 mm), 0.8–1.2 mm long, 1.2–1.5 mm wide, glabrous externally and internally. *Corolla lobes* white, much longer than the tube (ratio = 1.9–2.8:1), widely spreading from the base and recurved, 1.9–2.8 mm long, 0.6–0.8 mm wide at the base, glabrous externally, densely bearded internally; indumentum white, 0.6–0.8 mm long near apex; glabrous tip very short *c.* 0.1 mm long. *Anthers* usually partially exerted from the tube (by 3/4–7/8 of their length), occasionally fully exerted, 0.9–1.5 mm long, prominently recurved at apex; sterile tips conspicuous, white, 0.2–0.3 mm long. *Filaments* terete, 0.5–0.7 mm long, attached *c.* 2/3 above anther base, adnate to tube just below sinus. *Ovary* broadly or depressed obovoid, 0.4–0.5 mm long, 0.5–0.6 mm wide, appressed-hairy in the lower half, 3(4)-locular. *Style* 0.25–0.40 mm long, well-differentiated from ovary apex, included within the corolla tube; *stigma* not or scarcely expanded; *nectary* annular, 0.20–0.35 mm long, entire or very shallowly lobed, glabrous. *Fruit* ellipsoid or ovoid, 1.3–1.8 mm long, 0.8–1.1 mm wide, distinctly shorter than the calyx, truncate with a narrow, undulate, apical or subapical rim, the surface between the rim and the style base flat or ascending gently, hairy in the lower 2/3 with a rather sparse antrorse-appressed indumentums, hairs 0.2–0.3 mm long, smooth beneath the hairs; style persistent. (Figure 1)

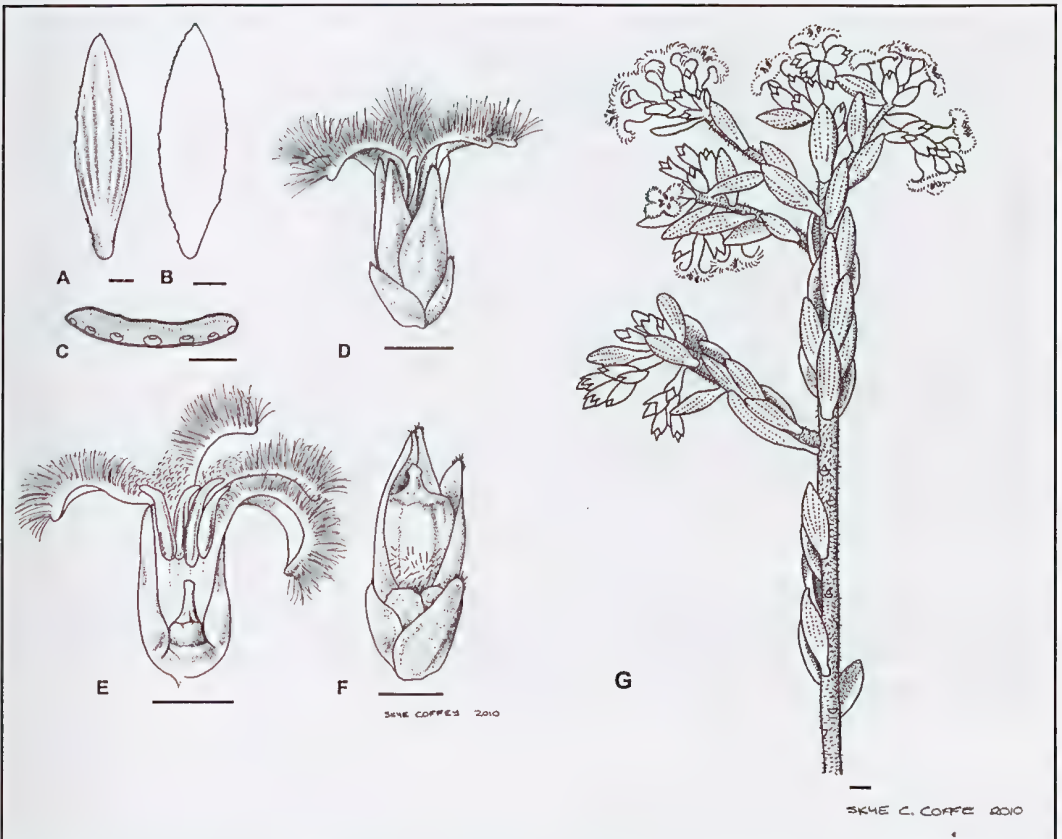


Figure 1. *Leucopogon maritimus*. A – leaf, abaxial surface; B – leaf, adaxial surface; C – leaf, section; D – flower; E – flower, longitudinal section; F – fruit; G – flowering branchlet. Scale bars: all = 1 mm. Drawn by Skye Coffey from *M. Hislop* 3769 (A–F), *M. Hislop* 3792 (G).

Other specimens examined. WESTERN AUSTRALIA: [localities withheld for conservation reasons] 27 June 1966, *M.D. Barrow* 3592 (PERTH); 27 Nov. 1996, *A.S. George* 17305 (CANB, PERTH); 10 May 1998, *M. Hislop* 1040 (CANB, NSW, PERTH); 13 Apr. 2008, *M. Hislop* 3746 (CANB, NSW, PERTH); 13 Apr. 2008, *M. Hislop* 3747 (CANB, MEL, PERTH); 2 May 2008, *M. Hislop* 3769 (HO, MEL, PERTH); 2 May 2008, *M. Hislop* 3772 (CANB, NSW, PERTH); 3 Aug. 2008, *M. Hislop* 3792 (CANB, NSW, PERTH); 21 Aug. 2007, *K. McCreery et al.* TR 1–OPP03 (PERTH); 20 Oct. 2007, *K. McCreery* EGRd5–1 (PERTH); 8 Mar. 2002, *K. Richardson* KCR 31 (PERTH); 14 June 2007, *K. Richardson* KCR 368 (PERTH); 9 Aug. 1960, *G.G. Smith s.n.* (PERTH).

Distribution and habitat. *Leucopogon maritimus* is restricted to near-coastal Quindalup dunes, from a small area of coastline about 40–70 km north of Perth (Figure 2). It occurs in deep, calcareous sands, on the mid to upper slopes of dunes or in shallow sand over limestone, but avoiding the thicker vegetation of the swales. It grows in low heathland communities often dominated by *Melaleuca systema*, *Acanthocarpus preissii*, *Acacia lasiocarpa* and *Olearia axillaris*, sometimes in close proximity to the common coastal epacrids *Leucopogon parviflorus* and *L. insularis*.

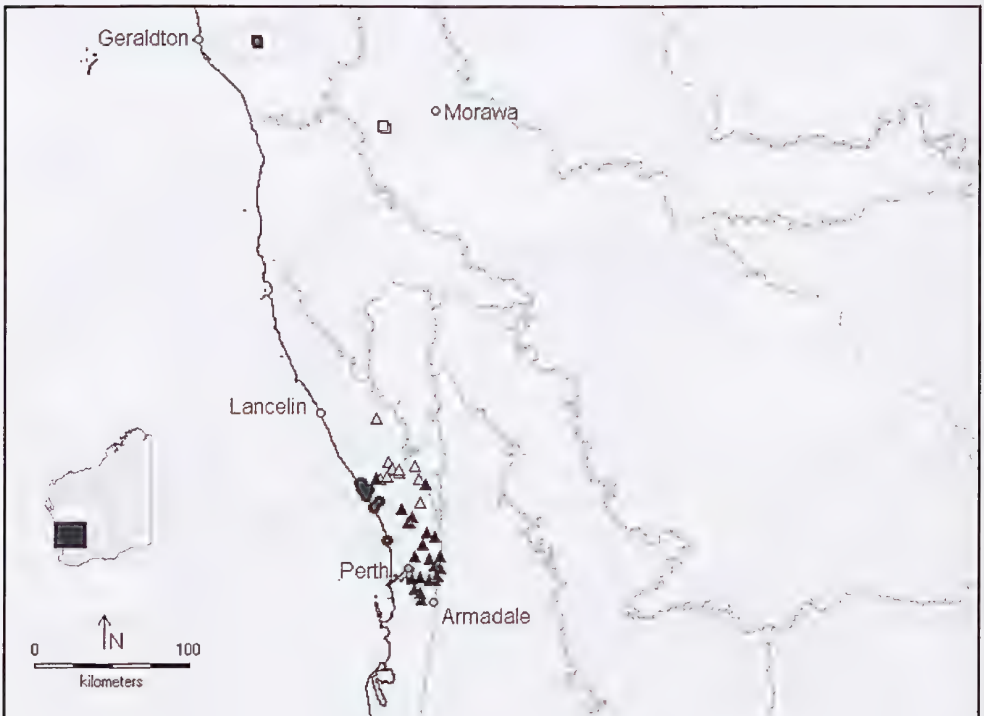


Figure 2. Distribution of *Leucopogon nitidus* (■), *L. stokesii* (□), *L. maritimus* (●), *L. squarrosus* subsp. *squarrosus* (▲) and *L. squarrosus* subsp. *trigynus* (△) in Western Australia.

Phenology. Flowering collections have been made between November and August, although in average seasonal conditions the peak is probably between April and June. Fruit is also likely to be present over many months but especially between June and September.

Etymology. From the Latin *maritimus* (by the sea), referring to the coastal distribution of this species.

Conservation status. Department of Environment and Conservation (DEC) Conservation Codes for Western Australian Flora: Priority One (Smith 2010, as *L. sp.* Perth coastal (A.S. George 17305)). Although locally common, most of the known distribution of *L. maritimus* is in areas proposed for future residential development. The southernmost record (*M.D. Barrow* 3592) collected in the mid 1960's has the vague locality 'Burns – Mullaloo'. This area has now been largely cleared of native vegetation and the species is quite likely to have already disappeared from there. The northern limit of its range has yet to be ascertained, but a thorough search by the author in a large area of coastal heath to the immediate south of the Moore River estuary (c. 12 km N of the most northerly current record), was unsuccessful.

Affinities. *Leucopogon maritimus* appears to be closely allied to *L. squarrosus* Benth., a species which occurs primarily on the Bassendean Sands of the Swan Coastal Plain. The drupes of the two have a very similar shape and indumentum, and both have sepals much longer than the mature fruit. In addition they have numerous, short, densely-flowered inflorescences which are aggregated into compact confluences. However they are readily distinguished by consistent foliar differences. *Leucopogon squarrosus* has leaves which are variable in orientation (from steeply antrorse to retrorse often on the same plant) and shape (variously obovate, elliptic or occasionally ovate), and which are always more or less recurved along their longitudinal axis, with the lamina frequently \pm stem-clasping in the lower half. By contrast in *L. maritimus* the leaves are consistently antrorse, usually steeply so, always narrowly elliptic, incurved along their longitudinal axis and never stem-clasping. The leaf bases in *L. squarrosus* are also very broad, with or without an obscure petiole, and usually occupy the entire width of the branchlet (excluding those on the main axes), whereas in *L. maritimus* the leaves are markedly narrowed towards the base, with the branchlet surface clearly visible on either side of a well-defined petiole. In addition *Leucopogon maritimus* has less acute sepals (relative to the typical subspecies of *L. squarrosus* only), which are generally shorter (1.9–3.0 mm long, but usually < 2.6 mm, compared to 2.5–3.6 mm long, usually > 2.8 mm in *L. squarrosus*), and shorter corolla tubes (0.8–1.2 mm long, cf. 1.0–1.8 mm in *L. squarrosus*). While the 3(4)-locular ovary of *Leucopogon maritimus* provides a further difference from the typical subspecies of *L. squarrosus* (2(–3)-locular), it is shared with subspecies *trigynus*. However, in addition to the foliar characters discussed above, these two can also be separated by style length: 0.25–0.40 mm long in *L. maritimus* compared to 0.50–0.70 mm in *L. squarrosus* subsp. *trigynus*.

Notes. Local endemism is rare in the flora of near-coastal, calcareous sands (Hopper & Gioia 2004), however other examples from the west coast of Western Australia are two recently described species, *Marianthus paralius* and *Hakea oligoneura*.

Leucopogon nitidus* Hislop, *sp. nov.

Leucopogi cinereo similis sed forma et indumento fructi differt in *L. nitido*; apice fructi plano vel ascendenti inter rimam et basim styli, pilis longis appressis praecipue in dimidio inferiore praesentibus; in *L. cinereo* apice fructi praecipue descendenti inter rimam et basim styli, pilis brevibus ad apicem restrictum; in *L. nitido* sepalis acutis vel subacutis non manifeste obtusis.

Typus: Kojarena [east of Geraldton], Western Australia [precise locality withheld for conservation reasons], 19 July 2008, *J. Brooker* 170 (*holo*: PERTH 07908024; *iso*: CANB, NSW).

Leucopogon sp. Kojarena (*J. Brooker* 232), Western Australian Herbarium, in *FloraBase*, <http://florabase.dec.wa.gov.au> [accessed June 2010]

Erect, open *shrubs* to 50 cm high and 50 cm wide; fire tolerance of the rootstock unknown although likely to be fire-sensitive. Young *branchlets* with a moderately dense to dense indumentum of patent, \pm straight or somewhat decurved hairs, 0.05–0.10 mm long. *Leaves* usually spirally arranged, occasionally opposite on a minority of branchlets, steeply antrorse, linear or very narrowly elliptic, 3.2–8.3 mm long, 0.5–0.8 mm wide; apex obtuse; base attenuate; petiole indistinct, yellowish, 0.1–0.3 mm long, shortly hairy on adaxial surface and margins, glabrous abaxially; lamina 0.35–0.50 mm thick, flat towards the base, becoming \pm trigonous in the upper half, straight or gently incurved along the longitudinal axis; surfaces \pm concolorous, shiny; adaxial surface usually sparsely hairy, especially towards the base, the venation not evident; abaxial surface with two deep grooves, one each side of the broad midrib, apparently glabrous, although short hairs are sometimes evident deep within the grooves; margins coarsely ciliate with stiff, antrorse hairs 0.05–0.20 mm long. *Inflorescences* erect, terminal and upper-axillary; axis 2–5 mm long, with 3–8 flowers, terminating in a bud-like rudiment or an attenuate point; axis indumentum of moderately dense, patent hairs 0.08–0.12 mm long; flowers erect and sessile. *Fertile bracts* narrowly ovate, obtuse, 1.9–2.6 mm long and 0.5–0.7 mm wide. *Bracteoles* ovate or broadly ovate, 1.2–1.5 mm long, 0.9–1.1 mm wide, obtuse or subacute, keeled; abaxial surface glabrous, becoming scarious towards the margins; adaxial surface shortly hairy in central portion; margins ciliolate. *Sepals* ovate, 2.0–2.4 mm long, 1.1–1.2 mm wide, acute or subacute; abaxial surface glabrous, greenish, often with some reddish-purple tinges towards the apex, the midrib somewhat raised, paler, other venation obscure, becoming scarious towards the margins; adaxial surface appressed-hairy in the upper half; the margins ciliolate with hairs 0.1–0.2 mm long. *Corolla tube* white, broadly campanulate, distinctly shorter than sepals, 0.9–1.3 mm long, 1.1–1.4 mm wide, glabrous externally and internally. *Corolla lobes* white, much longer than the tube (ratio = 2.3–3.1:1), widely spreading from the base and recurved, 2.5–2.9 mm long, 0.8–1.0 mm wide at the base, glabrous externally, densely hairy internally; indumentum white, distinctly shorter towards the base, 0.8–0.9 mm long near apex; glabrous tip *c.* 0.2 mm long. *Anthers* partially exerted from the tube (by 3/4–7/8 of their length), 1.3–1.6 mm long, prominently recurved at apex; sterile tips moderately conspicuous, 0.3–0.4 mm long. *Filaments* terete, 0.6–0.7 mm long, attached *c.* 2/3 above anther base, adnate to tube just below the sinus. *Ovary* broadly obovoid, rather angular, 0.5–0.6 mm long, 0.5–0.6 mm wide, sparsely appressed-hairy in the lower half, 3-locular. *Style* 0.4–0.5 mm long, tapering evenly from ovary apex, included within the corolla tube; *stigma* not or scarcely expanded; *nectary* annular, 0.3–0.4 mm long, very shallowly lobed, glabrous. *Fruit* \pm cylindrical, 2.1–2.3 mm long, 0.9–1.0 mm wide, slightly to distinctly longer than the calyx, with a well-defined, undulate, subapical rim, the surface between the rim and the style base either \pm level or more frequently ascending gently, hairy in the lower half with a rather sparse, steeply antrorse or antrorse-appressed indumentum, smooth beneath the hairs; style persistent. (Figure 3)

Other specimens examined. WESTERN AUSTRALIA: [localities withheld for conservation reasons] 11 July 2001, *J. Brooker* 232 (PERTH); 19 July 2008, *A. Chant* SEW 6 (PERTH).

Distribution and habitat. Apparently restricted to a small area east of Geraldton (Figure 2), where it grows on a hilltop in shallow sandy soil over laterite. The associated vegetation is heathland dominated by *Allocasuarina campestris*, *Banksia fraseri* var. *ashbyi* and *Hakea lissocarpha*.

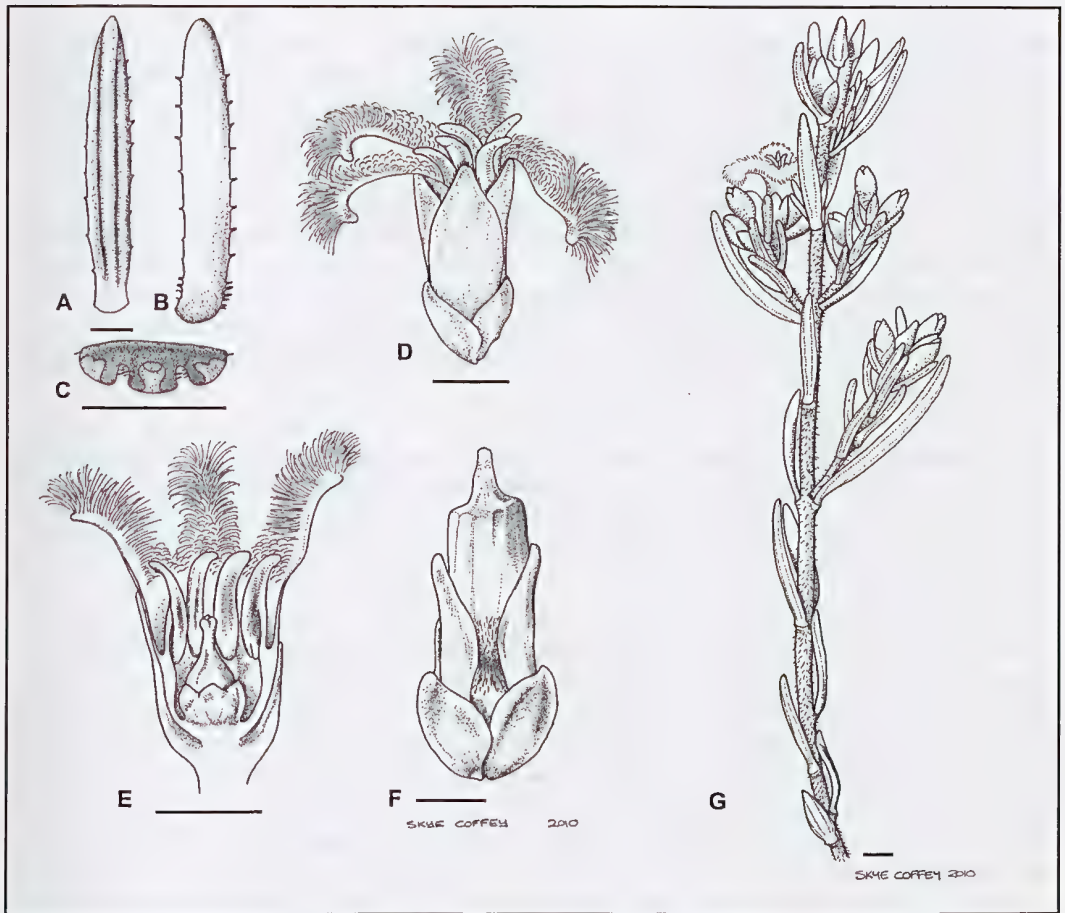


Figure 3. *Leucopogon nitidus*. A – leaf, abaxial surface; B – leaf, adaxial surface; C – leaf, section; D – flower; E – flower, longitudinal section; F – fruit; G – flowering branchlet. Scale bars: all = 1 mm. Drawn by Skye Coffey from J. Brooker 170 (A–G).

Phenology. The three collections were made in July and all have flower buds, flowers and mature fruit present. This suggests that, in common with other species discussed under *Notes* below, it is likely to have a prolonged flowering period largely determined by soil moisture levels.

Etymology. The epithet is from the Latin *nitidus* (shining, bright), in reference to the glossy leaf surfaces.

Conservation status. DEC Conservation Codes for Western Australian Flora: Priority One (Smith 2010, as *L. sp. Kojarena* (J. Brooker 232)). Currently known only from a single hilltop in a long-established farming district, where it is said to be scattered and not common. In winter of 2008 the species was the subject of an unsuccessful search by local botanist Ann Gunness, while engaged in surveys (commissioned by the Department of Environment and Conservation) of a number of conservation-coded taxa in the Geraldton area.

Affinities. In terms of its foliar morphology, *Leucopogon nitidus* is remarkably similar to *L. cinereus* E. Pritz., apparently differing only in having shiny leaves which lack a glaucous texture or long

spreading hairs, either or both of which are features of the latter species. It seems probable however that this similarity is the result of convergence, as the fruiting characters strongly suggest that the closest relatives of *L. nitidus* are members of a group of undescribed species which are widespread in the Geraldton Sandplains (refer under Notes below). In common with a number of other members of Group C (*sensu* Hislop & Chapman 2007), the drupe of *L. cinereus* terminates in a truncate and lobed rim beyond which the surface descends steeply to the style base (Figure 4). In *L. nitidus* by contrast, the rim is subterminal, more or less undulate, and with the surface flat or more usually ascending between the rim and style base. Although the drupe is hairy in both species, the indumentum type and distribution differ significantly. Whereas *L. nitidus* has long-appressed hairs on the lower surfaces of the drupe, *L. cinereus* has very short, patent hairs restricted to the fruit apex, between the rim and the style base. In addition to the differences in the fruit, *L. nitidus* has acute or subacute sepals (manifestly obtuse in *L. cinereus*) and a broad style base which tapers evenly from the ovary apex (cf. narrow and abruptly differentiated).

Notes. The presence, orientation and distribution of hairs on the drupes of *Leucopogon s. str.* is usually a reliable taxonomic character at the species level and also has some utility in subgeneric classification. For instance, whereas no species from Groups A or B (*sensu* Hislop & Chapman 2007), have an indumentum on their fruit, all but one in Group E have a hairy fruit and it is a diagnostic feature for a number of species in Group C.

Narrow fruit with a distinctive, long, antrorse-appressed indumentum is a feature *Leucopogon nitidus* has in common with the following five phrase-named taxa: *L. sp.* Watheroo (R.D. Royce 9616) (this taxon has until very recently been generally misidentified as *L. phyllostachys* Benth.), *L. sp.* Arrowsmith (M. Hislop 2509), *L. sp.* Cataby (F. Hort 1638), *L. sp.* Lesueur (B. Evans 530) and *L. sp.* South Eneabba (E.A. Griffin 8027). These taxa have largely parapatric distributions in the Geraldton sandplains between Cataby and Geraldton. The drupe apex is truncate and very similar to the members of Group C, although with a narrow and sometimes indistinct apical rim. Aside from the fruiting similarities the six taxa also have the following characters in common: more or less acute sepals, a 2- or 3-locular ovary and an unusually prolonged flowering period, which uncommonly in *Leucopogon s. str.* (especially in the Geraldton sand-plains), includes the summer–autumn period. Taken together, these shared characters suggest a close relationship. The wider affinities of this northern group however are rather problematic as aspects of their morphology could be regarded as intermediate between Groups C & D. This was the reason that *L. phyllostachys auct. non* Benth. (i.e. the taxon now referred to *Leucopogon sp.* Watheroo) and *L. squarrosus* (refer Notes under that species) were assigned only tentatively to Group D in Hislop & Chapman (2007). Recent examination of type material of *L. phyllostachys* has led to the realization that the name had been wrongly applied. The true *L. phyllostachys* is an apparently uncommon species from the Stirling Range, and is unequivocally a member of Group D.

Leucopogon squarrosus Benth. in Endlicher, S.F.L., Fenzl, E., Bentham, G. & Schott, H.W., *Enum. Pl.*: 77 (1837). *Styphelia squarrosa* (Benth.) F. Muell., *Fragm.* 6: 31 (1867). *Type*: Swan River Colony [near Perth, Western Australia], 27 November–19 December 1833, *C.A.A.F. von Hügel s.n.* (*lecto, here designated*: W 0004483, image seen; *isolecto*: K 000348476!).

Erect *shrub* to c. 150 cm high and 120 cm wide, but usually smaller, single-stemmed at ground level with a fire-sensitive rootstock. Young *branchlets* usually with a sparse to moderately dense, often rather irregular indumentum of patent, straight or somewhat decurved hairs, 0.05–0.20 mm long, occasionally ± glabrous. *Leaves* highly variable, spirally arranged, variously orientated, usually ± antrorse, but sometimes varying between steeply antrorse and ± retrorse on the same plant, variously

obovate or elliptic, less often ovate, 2.2–8.2 mm long, 0.9–4.4 mm wide; apex acute, acuminate, subacute or obtuse; the base broad, cuneate or attenuate; petiole \pm absent to c. 0.3 mm long; lamina 0.15–0.30 mm thick, varying from strongly concave or \pm flat to slightly convex adaxially, the basal half often stem-clasping, longitudinal axis always recurved, often markedly so; surfaces discolorous or \pm concolorous, matt or slightly shiny; adaxial surface glabrous or with a few hairs close to the base, venation not evident; abaxial surface usually somewhat paler, glabrous, with 5–9 primary veins which vary from \pm flat to conspicuously raised, the midrib more prominent than the others, especially towards the apex; margins mostly glabrous throughout, occasionally minutely and irregularly ciliate. *Inflorescences* erect, terminal and upper-axillary, often aggregated into dense conflorescences; axis 3–9 mm long with 5–14 densely arranged flowers, terminating in a bud-like rudiment or an attenuate point, the latter relatively long and conspicuous within the inflorescence; axis indumentum of moderately dense to dense patent hairs 0.1–0.3 mm long; flowers erect and sessile. *Fertile bracts* narrowly ovate, 1.7–2.4 long, 0.6–0.8 mm wide, acute or acuminate. *Bracteoles* narrowly ovate or ovate, 1.5–2.6 mm long, 0.8–1.3 mm wide, acuminate or acute, sharply keeled; abaxial surface glabrous, apart sometimes for a few hairs about the keel apex, broadly scarious towards the margins; abaxial surface shortly hairy in central portion; margins glabrous in basal half, usually minutely ciliate towards the apex. *Sepals* narrowly ovate, 2.5–3.6 mm long, 0.8–1.4 mm wide, acuminate, acute or subacute; abaxial surface usually glabrous or very shortly hairy, very occasionally with longer \pm spreading hairs, the central portion pale greenish or straw-coloured, sometimes flushed pale pink, the midvein usually evident and often raised towards the apex, becoming scarious towards the margins; adaxial surface mostly glabrous but with a few inconspicuous short hairs in the upper half; margins glabrous in basal half, usually minutely ciliate towards the apex. *Corolla tube* white, campanulate, or broadly campanulate, much shorter than the sepals (by up to 1.7 mm), 1.0–1.8 mm long, 0.8–1.5 mm wide, glabrous externally and internally. *Corolla lobes* white, much longer than the tube (ratio = 1.5–2.3:1), widely spreading from the base and recurved, 2.1–3.0 mm long, 0.5–0.7 mm wide at the base, glabrous externally, densely bearded internally; indumentum white, 0.8–1.0 mm long near apex; glabrous tip 0.2–0.3 mm long. *Anthers* partially exserted from the tube (by 2/3–3/4 of length), 1.0–1.9 mm long, prominently recurved at apex; sterile tips conspicuous, white 0.25–0.40 mm long. *Filaments* terete, attached 1/2–2/3 above anther base, 0.5–0.8 mm long, adnate to the tube just below the sinus. *Ovary* obovoid or depressed-obovoid, 0.4–0.5 mm long, 0.4–0.6 mm wide, appressed-hairy in the lower half, 2–3(4)-locular. *Style* 0.30–0.70 mm long, well-differentiated from the ovary apex, included within the corolla tube; *stigma* not or barely expanded; *nectary* annular, 0.20–0.40 mm long, \pm truncate. *Fruit* ellipsoid or ovoid, 1.3–1.9 mm long, 0.8–1.1 mm wide, much shorter than the calyx, \pm truncate, with an often rather indistinct apical or subapical rim, occasionally absent, the surface with a sparse to moderately dense indumentum of steeply antrorse hairs, 0.2–0.3 mm long, smooth beneath the hairs; style persistent.

Notes. The fruiting character of *Leucopogon squarrosus* and *L. maritimus* is very similar to that of the northern group of species discussed under *L. nitidus*, differing only in having a proportionally shorter and broader fruit which is always markedly shorter than the sepals. Other significant characters that this species-pair have in common with the northern group are the 2–3 locular ovary and acute sepals. Members of the northern group lack the conspicuously aggregated inflorescences seen in *L. squarrosus* and *L. maritimus*.

Two subspecies are recognised. They differ mainly in locule number and style length.

a. *Leucopogon squarrosus* Benth. subsp. *squarrosus*

Leucopogon squarrosus var. *paradoxus* Sond. in C. Lehmann, *Pl. Preiss.* 1: 318 (1845). Type: 'Herb. Preiss. No. 403 ex parte' (*holo*: ?LD, *n.v.*).

Leucopogon brachycephalus DC. var. *heterophyllus* Sond. in C. Lehmann, *Pl. Preiss.* 1: 308 (1845). Type: 'In limoso-calculosis ad radices jugi montium Darling's-range' [Western Australia], 15 Oct. 1839, *L. Preiss* 383 (*lecto*, here designated: MEL 75846!).

Shrubs to c. 70 cm high and 70 cm wide. *Leaves* variously obovate or elliptic, less often ovate, 2.2–5.0 mm long, 0.9–3.1 mm wide; apex usually acute or acuminate, occasionally subacute or ± obtuse. *Sepals* acuminate or acute. *Ovary* 2(–3)-locular. *Style* 0.3–0.5 mm long. (Figure 4)

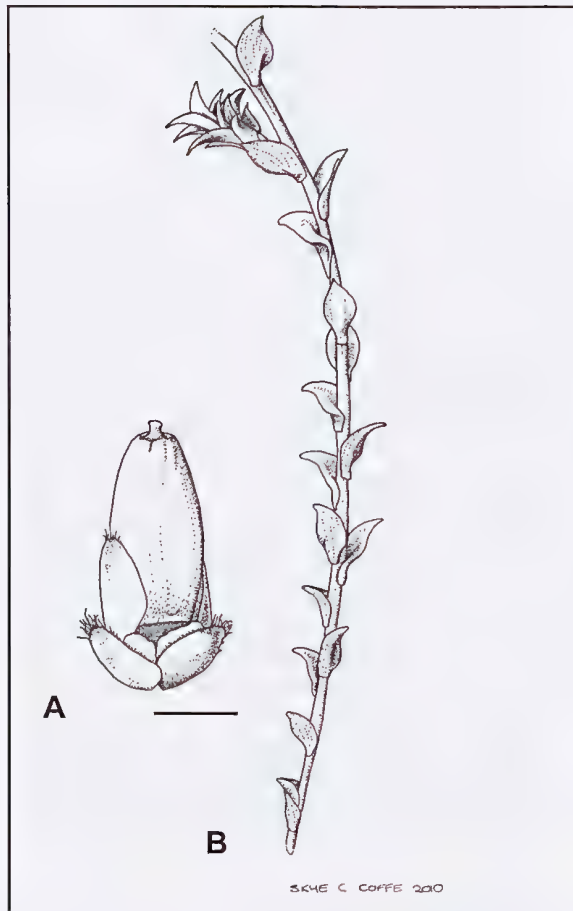


Figure 4. *Leucopogon cinereus*. A – fruit. *Leucopogon squarrosus* subsp. *squarrosus*. B – branchlet. Scale bars: both = 1 mm. Drawn by Skye Coffey from *M. Hislop* 3832 (A), *M. Hislop* 2128 (B).

Other specimens examined. WESTERN AUSTRALIA: Forrestfield Reserve, Forrestfield, Oct. 1967, *S.J.J. Davies* 4021 (PERTH); foot of Zig Zag [Road], Gooseberry Hill, 30 June 1961, *A.S. George* 2613 (PERTH); University of Western Australia, Botanic Reserve, bounded by Brook, Bickley and Boundary roads, Kenwick 1 Oct. 1992, *N. Gibson & M.N. Lyons* 1484 (PERTH); Redwood Rd NE of Yanchep, 1 Mar. 1966, *J. Havel* 258 (PERTH); remnant vegetation S of rubbish tip access Rd and W of Livingstone Rd, Canning Vale, 14 June 1997, *M. Hislop* 716 (PERTH); remnant bushland, adjacent Active Industries, N of Kenneth Rd, High Wycombe, 4 July 1999, *M. Hislop* 1323 (CANB, PERTH); Coastal Walk Trail, towards N boundary of Melaleuca Park, W of Bullsbrook, 17 Sep. 2000, *M. Hislop* 2128 (PERTH); northern end of Bush Forever Site 253, Jandakot Regional Park on W side of transmission line access track E of Warton Rd, Forrestdale, 16 Oct. 2003, *M. Hislop* 3068 (NSW, PERTH); Perry Rd Wanneroo, 8.5 km N of Chitty Rd, on E side of road, 8 Oct. 2002, *F. & J. Hort* 1862 (CANB, PERTH); along western boundary of Breera Road Nature Reserve, Gingin South, 4 Aug. 2008, *F. & J. Hort* 3220 (CANB, NSW, PERTH); Whiteman Park [N of Beechboro], 19 Oct. 1994, *B.J. Keighery* 2026 (PERTH); Talbot Road Reserve, Midland, 28 March 1992, *G.J. Keighery* 13780 (PERTH); Riverton, 18 July 1848, *Bro. Kissane* 23 (PERTH); Gngangara–Moore River State Forest, Melaleuca Block, 480 m W along unnamed firebreak from T junction on northern end of Buloke Rd, 120 m N of firebreak, 14.5 km SW of Bullsbrook GSS site PC6B, 19 Sep. 2008, *D.A. Mickle & M.L. Swinburn* 502 (PERTH); White Rd Plot 1, c. 120 m from Kelvin Rd, and 80 m from White Rd, Orange Grove, 19 July 2006, *J. Pryde & M. Hoskins* MM 7 (PERTH); Cannington, 19 Aug. 1948, *R.D. Royce* 2606 (PERTH); Upper Swan, 3 July 1918, *F.M.C. Schock* 338 (CANB, PERTH); north of Gngangara Rd, NE part of Lot 46 Maralla Rd, locality of Ellenbrook, 8 Aug. 1999, *M. & M. Trudgen* MET 20036 (CANB, PERTH).

Distribution and habitat. Restricted to the Swan Coastal Plain, from the southern suburbs of Perth near Forrestdale northwards to south-west of Gingin (Figure 2). Occurs on Bassendean Sands, mostly in low-lying situations, either as a component of the understory of *Banksia* woodland or in winter-damp heathland.

Conservation status. Much of the geographic range of this species lies within what is now the greater Perth metropolitan area and is consequently very fragmented, especially in the south. Although it doesn't currently fit criteria for inclusion on the DEC Conservation Priority list, the status of this species as a regional endemic in an area of rapid development should be given due consideration when assessing future clearing applications.

Notes. Although the locule number of the typical subspecies is consistently two in most specimens, very occasionally there is a mixture of 2- and 3-locular ovaries (e.g. *G.J. Keighery* 13780). Where this occurs, the other characters used here to separate between the subspecies, especially style length, are those of subsp. *squarrosus*.

Sonder (1845) recognised *Leucopogon squarrosus* var. *paradoxus* Sond. on the basis of minor differences in leaf shape and orientation. Such differences are common between and even within populations of many species of *Leucopogon* and *L. squarrosus* is particularly variable in its foliar morphology. The fact that the collection (*L. Preiss* 403) used by Sonder as the type of var. *paradoxus* has the same collecting number that he had previously cited under the typical variety, and therefore was very likely to be from the same gathering, suggests that the former merely represents infra-populational variation. However this remains to be confirmed as type material of var. *paradoxus* has not yet been located by the author.

Leucopogon brachycephalus var. *heterophyllus* Sond. is the typical subspecies of *L. squarrosus* but with unusually short leaves and sepals. The lectotype of the former designated here is from Sonder's own collection.

b. *Leucopogon squarrosus* Benth. subsp. *trigynus* Hislop subsp. nov.

A subspecies typico ovario 3(4)-loculari et stylo longiore differt.

Typus: Yeal Nature Reserve, west of Gingin, Western Australia [precise locality withheld for conservation reasons], 20 June 2010, *M. Hislop* 4039a (*holo*: PERTH 08227810; *iso*: CANB, MEL, NSW).

Shrubs to c. 150 cm high and 120 cm wide. *Leaves* obovate, often broadly so, 2.8–8.2 mm long, 1.7–4.4 mm wide; apex usually subacute or obtuse, less often acute. *Sepals* acute or subacute. *Ovary* 3(4)-locular. *Style* 0.5–0.7 mm long.

Other specimens examined. WESTERN AUSTRALIA: [localities withheld for conservation reasons] 15 July 1965, *J.C. Anway* 528 (PERTH); 1 Oct. 1932, *W.E. Blackall* 2972 (PERTH); 4 Aug. 1965, *S.J.J. Davies s.n.* (PERTH); 27 June 1980, *J. Dodd* 72 (PERTH); 22 July 1993, *N. Gibson & M.N. Lyons* 1321 (PERTH); 20 July 1993, *N. Gibson & M.N. Lyons* 1334 (PERTH); 29 Apr. 1966, *J. Havel* 269 (PERTH); 13 July 1966, *J. Havel* 292 (PERTH); 8 June 2010, *M. Hislop* 4036 (CANB, NSW, PERTH); 20 June 2010, *M. Hislop* 4040 (CANB, NSW, PERTH); 28 Oct. 1993, *B.J. Keighery & N. Gibson* 160 (PERTH); 11 June 1962, *F.G. Smith* 1662 (PERTH); July 1939, *Miss Tape s.n.* (PERTH).

Conservation status. Recently listed under DEC Conservation Codes for Western Australian Flora as Priority Two. Apparently restricted to a small part of the Swan Coastal Plain. Recent collections have all been from an area to the west and south-west of Gingin where it is locally common in the Yeal Nature Reserve. There are two old specimens with the vague localities of 'Jurien Bay Road' (*Miss Tape s.n.*) and 'Moore River' (*F.G. Smith* 1662). An effort by the author to find the taxon in apparently suitable habitat at the southern end of Moore River National Park was unsuccessful.

Notes. Although no mention is made of locule number or style length, Wheeler (1987) appears to refer, at least in part, to this taxon when she makes note after her treatment of *L. squarrosus* of 'a variant from between Upper Swan and Moore River [which] has larger, more erect and less squarrose leaves often with a broad, stem-clasping base [and which] often [has] less acute sepals'.

The distributions of the two subspecies approach each other very closely in an area south-west of Gingin and it appears that they may be narrowly sympatric. In this regard two collections made along the same track (Redwood Rd, NE of Yanchep) in 1966 are of particular interest. One of these (*J. Havel* 258) is the typical subspecies, collected in early March, the second (*J. Havel* 292) is subsp. *trigynus* and was collected in mid July. It is not known how close to one another these collections were made as no distances were given, but the track is about twelve kilometres long. The two collections have all of the diagnostic features of their respective subspecies.

***Leucopogon stokesii* Hislop, sp. nov.**

A *Leucopogi pulchello* facie subtus folii plana non carinata, ovario 3–4- vice 4–5 loculari, apice fructi plano vel ascendenti inter rimam et basim styli vice praeceps descendenti differt.

Typus: north-east of Arrino Western Australia [precise locality withheld for conservation reasons], 9 August 2009, M. Hislop & J. Borger MH 3905 (*holo*: PERTH 08130868; *iso*: CANB, NSW).

Leucopogon sp. Dudawa (M. Hislop & J. Borger MH 3829), Western Australian Herbarium, in *FloraBase*, <http://florabase.dec.wa.gov.au> [accessed June 2010]

Erect, open *shrubs* to c. 160 cm high and 150 cm wide, single-stemmed at ground level with a fire-sensitive rootstock. Young *branchlets* with a sparse to moderately dense indumentum of straight or slightly decurved, patent hairs, 0.05–0.2 mm long. *Leaves* spirally arranged, steeply antrorse, narrowly elliptic, 3.2–7.2 mm long, 0.8–1.8 mm wide; apex obtuse; base attenuate or rarely cuneate; petiole usually well-defined, creamy-yellow to pale brown, 0.4–1.1 mm long, glabrous; lamina 0.3–0.4 mm thick, adaxially concave, gently incurved along the longitudinal axis; surfaces glabrous, markedly discolorous; adaxial surface dull, glaucous, the venation not evident; abaxial surface darker, shiny, \pm smooth, the venation indistinct with 3–5 primary veins faintly discernible; margins glabrous or sparsely ciliolate with coarse hairs to 0.5 mm long. *Inflorescences* erect, mostly terminal with little upper-axillary development; axis 3–7 mm long, with 5–10 rather densely arranged flowers, terminating in a bud-like rudiment; axis indumentum of moderately dense hairs, mostly c. 0.05 mm long; flowers erect and sessile. *Fertile bracts* narrowly ovate, 1.4–3.1 mm long, 0.7–0.9 mm wide, obtuse. *Bracteoles* ovate or broadly ovate, 1.2–1.5 mm long, 0.9–1.2 mm wide, obtuse, keeled, although sometimes rather obscurely so; abaxial surface glabrous, apart from a few short hairs at the apex, becoming scarious towards the margins; adaxial surface sparsely and minutely hairy; margins ciliolate. *Sepals* ovate, 2.0–2.9 mm long, 1.0–1.5 mm wide, obtuse; abaxial surface glabrous, greenish in the central portion, often suffused purple towards the apex and in a submarginal band, becoming scarious towards the margins, the venation obscure apart from the pale midrib; adaxial surface sparsely and minutely hairy; margins minutely ciliolate with hairs to c. 0.08 mm long. *Corolla tube* white, campanulate or broadly campanulate, shorter than the sepals, 1.3–1.8 mm long, 1.3–1.5 mm wide, glabrous externally and internally. *Corolla lobes* white, usually flushed pink in the upper half, much longer than the tube (ratio = 1.5–2.3:1), widely spreading from the base and recurved, 2.4–3.0 mm long, 0.7–1.0 mm wide at the base, glabrous externally, densely bearded internally; indumentum white, 0.7–1.2 mm long near apex; glabrous tip 0.1–0.2 mm long. *Anthers* partially exerted from the tube (by 2/3–3/4 of their length), 1.4–2.0 mm long, recurved towards apex; sterile tips conspicuous, white, 0.4–0.7 mm long. *Filaments* terete, 0.7–0.9 mm long, attached c. 2/3 above anther base, adnate to the tube just below the sinus. *Ovary* broadly ellipsoid to broadly obovoid, 0.5–0.6 mm long, 0.5–0.6 mm wide, glabrous, 3–4(5)-locular. *Style* 0.4–0.7 mm long, tapering smoothly from a broad base, included within the corolla tube; *stigma* not or barely expanded; *nectary* annular, 0.25–0.40 mm long, entire or shallowly lobed for up to 1/4 of its length, glabrous. *Fruit* oblongoid or ellipsoid, glabrous, smooth, 1.8–2.5 mm long, 1.1–1.3 mm wide, longer than the calyx, bluntly angular in transverse section, with a moderately well-defined, subapical rim, the surface between the rim and the style base flat or ascending gently; style persistent. (Figure 5)

Other specimens examined. WESTERN AUSTRALIA: [localities withheld for conservation reasons] 25 Sep. 2009, J. Borger DS 259-6 (CANB, PERTH); 10 Sep. 2008, M. Hislop & J. Borger MH 3829 (CANB, NSW, PERTH); 9 Aug. 2009, M. Hislop & J. Borger MH 3899 (CANB, MEL, NSW, PERTH).

Distribution and habitat. Known only from a small area north-east of Three Springs (Figure 2). The species occurs on and immediately below breakaways in rocky, grey loam over sandstone, where it grows in dense heath, usually dominated by *Melaleuca* spp.

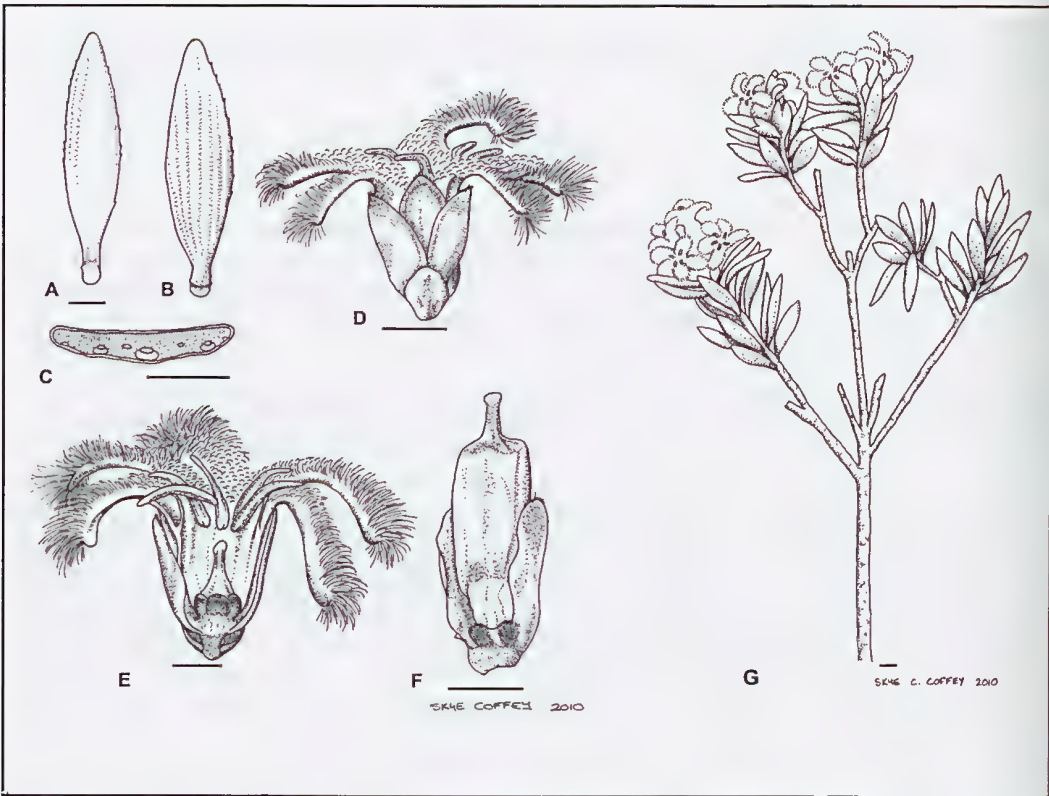


Figure 5. *Leucopogon stokesii*. A – leaf, adaxial surface; B – leaf, abaxial surface; C – leaf, section; D – flower; E – flower, longitudinal section; F – fruit; G – flowering branchlet. Scale bars: all = 1 mm. Drawn by Skye Coffey from M. Hislop & J. Borger MH 3905 (A–F), J. Borger DS 259-6 (G).

Phenology. Flowers between July and September. Mature fruit has been collected in the second half of September but is probably present from late August at least until early October.

Etymology. The specific name honours Dennis Stokes, farmer and naturalist, on whose property this species occurs, and who has made considerable efforts towards the conservation of what are undoubtedly some of the most interesting and valuable tracts of natural vegetation in the district.

Conservation status. DEC Conservation Codes for Western Australian Flora: Priority One (Smith 2010, as *L. sp.*Dudawa (M. Hislop & J. Borger MH 3829)). The only known populations are from a large system of breakaways on private property. The surface geology here is a locally uncommon sandstone of the Nangetty Formation (Baxter & Lippel 1985). Other breakaways in the general area have either been cleared, subject to intensive grazing or are of a different geology. Because of what appear to be very specific habitat requirements in an area heavily cleared for agriculture, the potential for the discovery of additional populations of this species seems limited.

Affinities. While floral and fruiting characters place *Leucopogon stokesii* in Group C (*sensu* Hislop & Chapman 2007), its close affinities are not obvious, and it is unlikely to be confused with any other species from the Midwest or indeed the Geraldton sand-plains as a whole. In gross morphology it

somewhat resembles *L. pulchellus* Sond., a variable species which, in the broad sense, occurs from the northern Darling Range to the far south-west corner of Western Australia. Aside from the geographical disjunction it can be readily separated from *L. pulchellus* by a comparison of the abaxial leaf surfaces, which in the latter are prominently keeled towards the apex, whereas in *L. stokesii* they are smoothly concave throughout. Additionally the ovary locule number in *L. pulchellus* is usually 5, occasionally 4 (usually 3 or 4 in *L. stokesii*, occasionally 5), and the surface of the fruit apex descends steeply to the style base (cf. flat or gently ascending).

Notes. *Leucopogon stokesii* shows surprising floral variation within its very restricted distribution. The relatively wide range, for example, in the lengths of the style, sepals and corolla hairs are of a magnitude that might be expected of a widespread species rather than a local endemic. And while there is variation in locule number among some members of Group C, it is uncommon for species of *Leucopogon s. str.* generally to have a locule number which varies by more than one. For example those species which usually have a three locular ovary may sometimes also have four locules, but it is unusual for them to have five. Similarly those with a standard 5-locular ovary not uncommonly also have flowers with four locules, but rarely three. Again this degree of variation is otherwise only occasionally encountered in widespread species, such as *L. sprengelioides* Sond.

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